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1	830987	moisture or wet$	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:05
2	4301228	indicat$ or detect$	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:21
3	59802	(moisture or wet$) same (indicat$ or detect$)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:22
4	28299	(moisture or wet$) with (indicat$ or detect$)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:23
5	73388	422/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:24
6	969	((moisture or wet$) with (indicat$ or detect$)) and 422/$.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:25
7	14586	methine	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:37
8	62	((moisture or wet$) with (indicat$ or detect$)) and methine	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:26
9	5075	methine near5 (indicator or dye)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:39
10	56	((moisture or wet$) same (indicat$ or detect$)) and (methine near5 (indicator or dye))	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 13:45
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13	1203	116/211,200,227.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 14:15

14	81	(moisture or wet$) and 116/211,200,227.ccls.	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 14:15
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16	0	methine and (((moisture or wet$) same (indicat$ or detect$)) and 116/211,200,227.ccls.)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/03/03 14:16

United States Patent [19]

Timmons et al.

[11] **4,022,211**

[45] **May 10, 1977**

[54] **WETNESS INDICATOR FOR ABSORBENT PADS**

[75] Inventors: **Terry K. Timmons; Dan D. Endres,** both of Appleton, Wis.

[73] Assignee: **Kimberly-Clark Corporation,** Neenah, Wis.

[22] Filed: **Oct. 8, 1975**

[21] Appl. No.: **620,659**

Related U.S. Application Data

[63] Continuation of Ser. No. 497,475, Aug. 14, 1974, abandoned.

[52] **U.S. Cl.** ..... **128/287**; 116/114 R

[51] **Int. Cl.²** **A61F 13/16**

[58] **Field of Search** ..... 128/284, 287, 288, 286, 128/290 R, 296; 116/114 AM, 114 R, 114 AJ

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2,249,867	7/1941	Snelling	116/114 AM X
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3,759,261	9/1973	Wang	128/287
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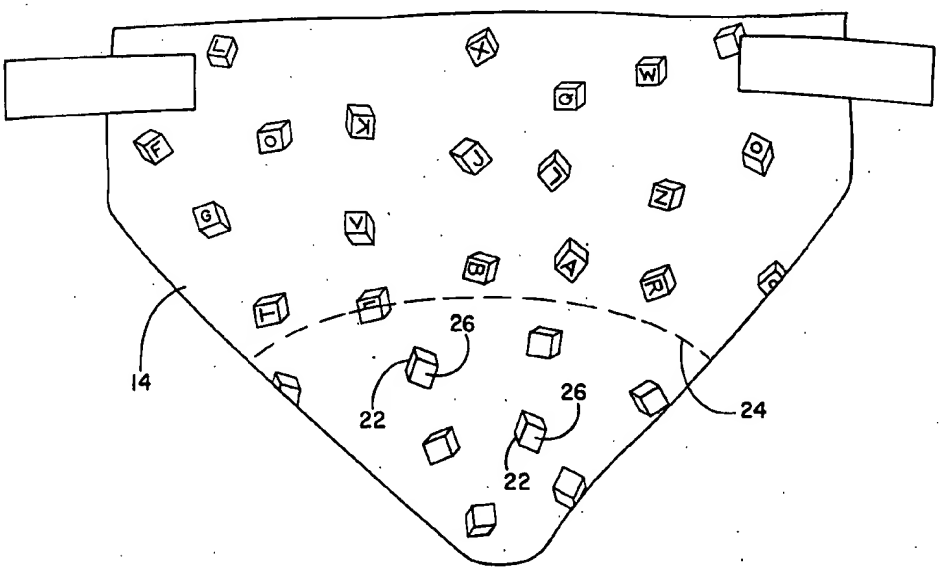
3,952,746	4/1976	Summers	128/287

Primary Examiner—Clifford D. Crowder
Attorney, Agent, or Firm—Daniel J. Hanlon, Jr.; William D. Herrick; Raymond J. Miller

[57] **ABSTRACT**

A wetness indicator for an absorbent pad assembly in which the pads have light-transmitting backing sheets. The indicator comprises a water-dispersible or water-soluble coloring agent affixed to a carrier means adjacent the absorbent pad and of sufficient intensity to be readily visible through the backing sheet when the pad is dry but which after being wetted by aqueous body fluids becomes substantially invisible. The coloring agent may be used by itself or with a suitable binder. It may also be used alone or in combination with a permanent color pattern or design which latter remains visible after wetting.

19 Claims, 6 Drawing Figures



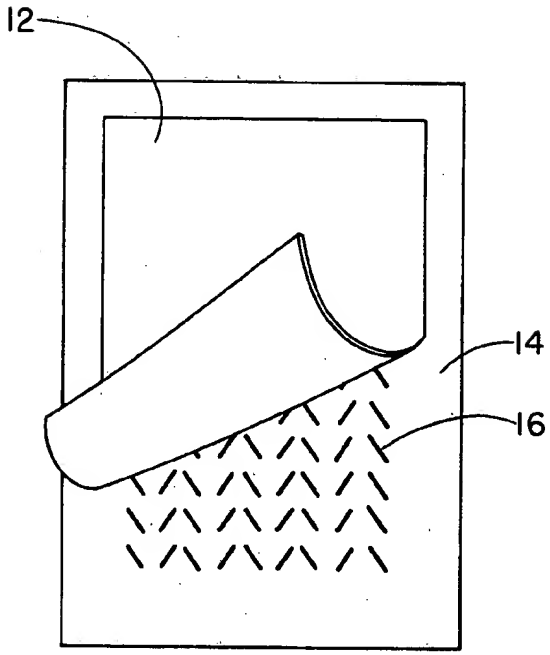


FIG. 1

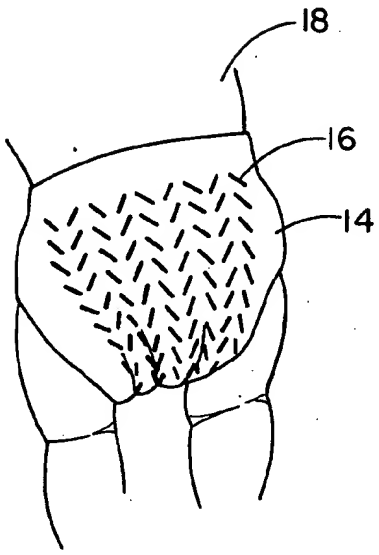


FIG. 2

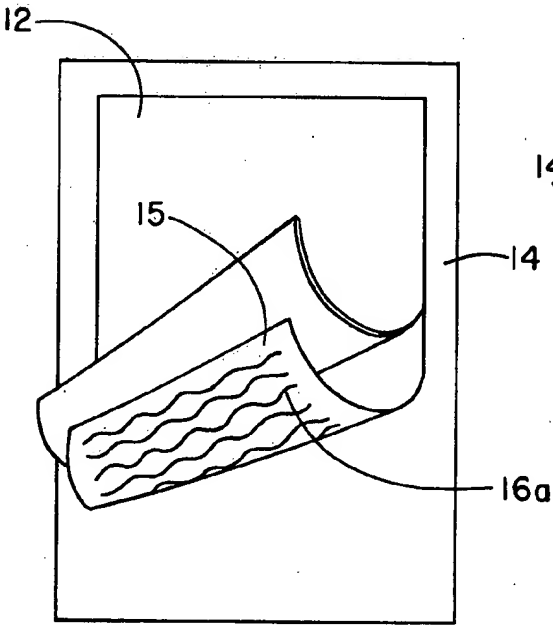


FIG. 4

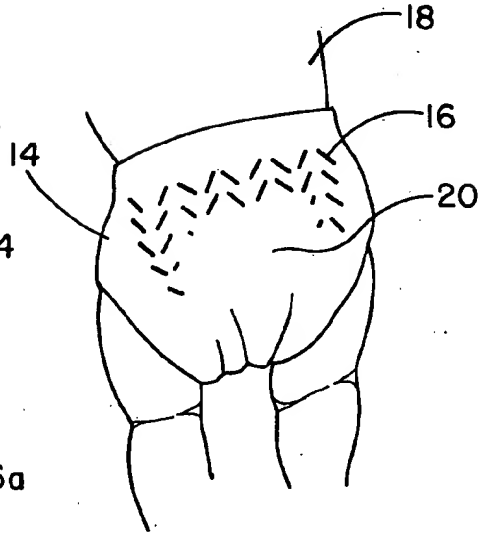


FIG. 3

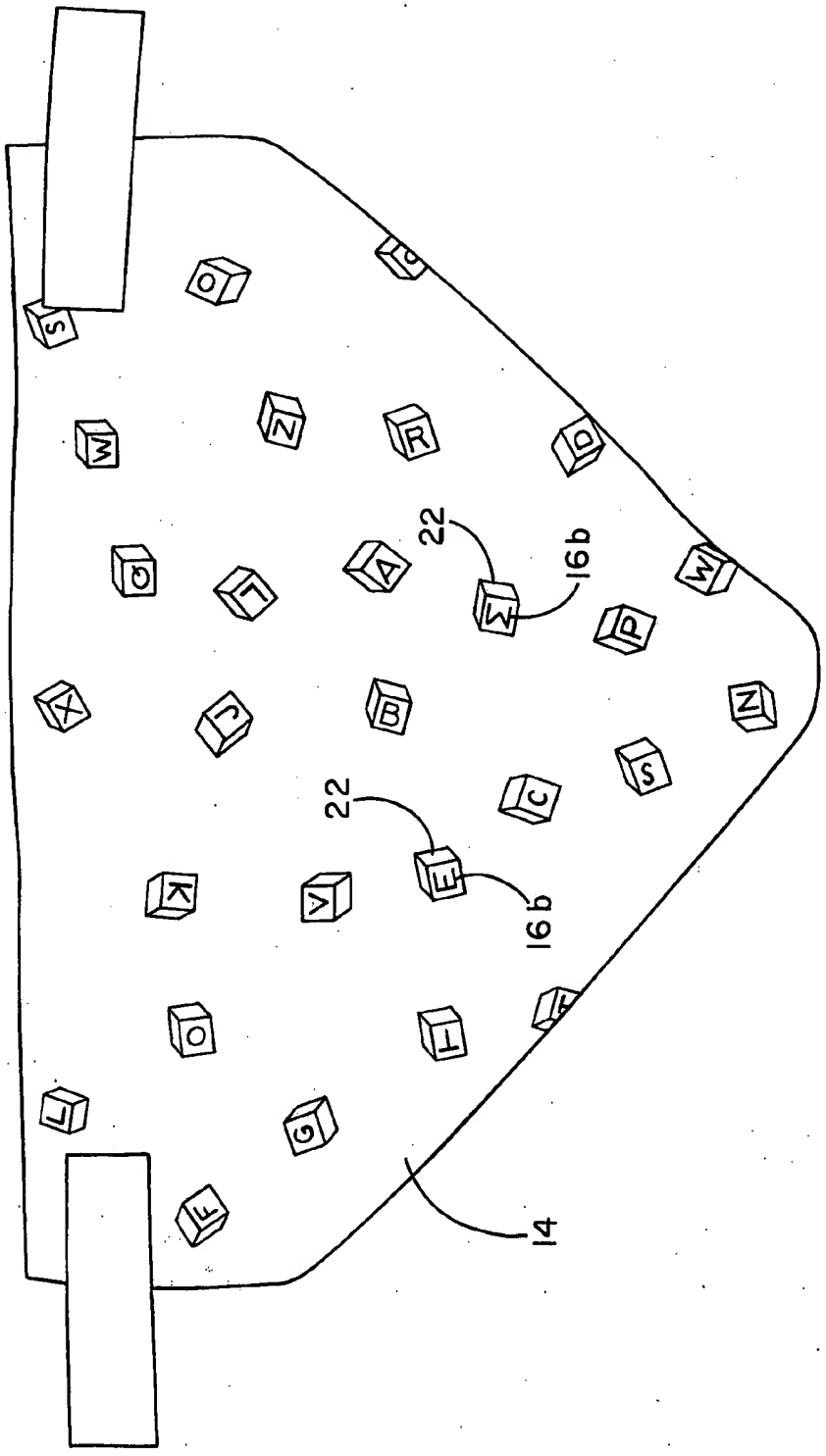


FIG. 5

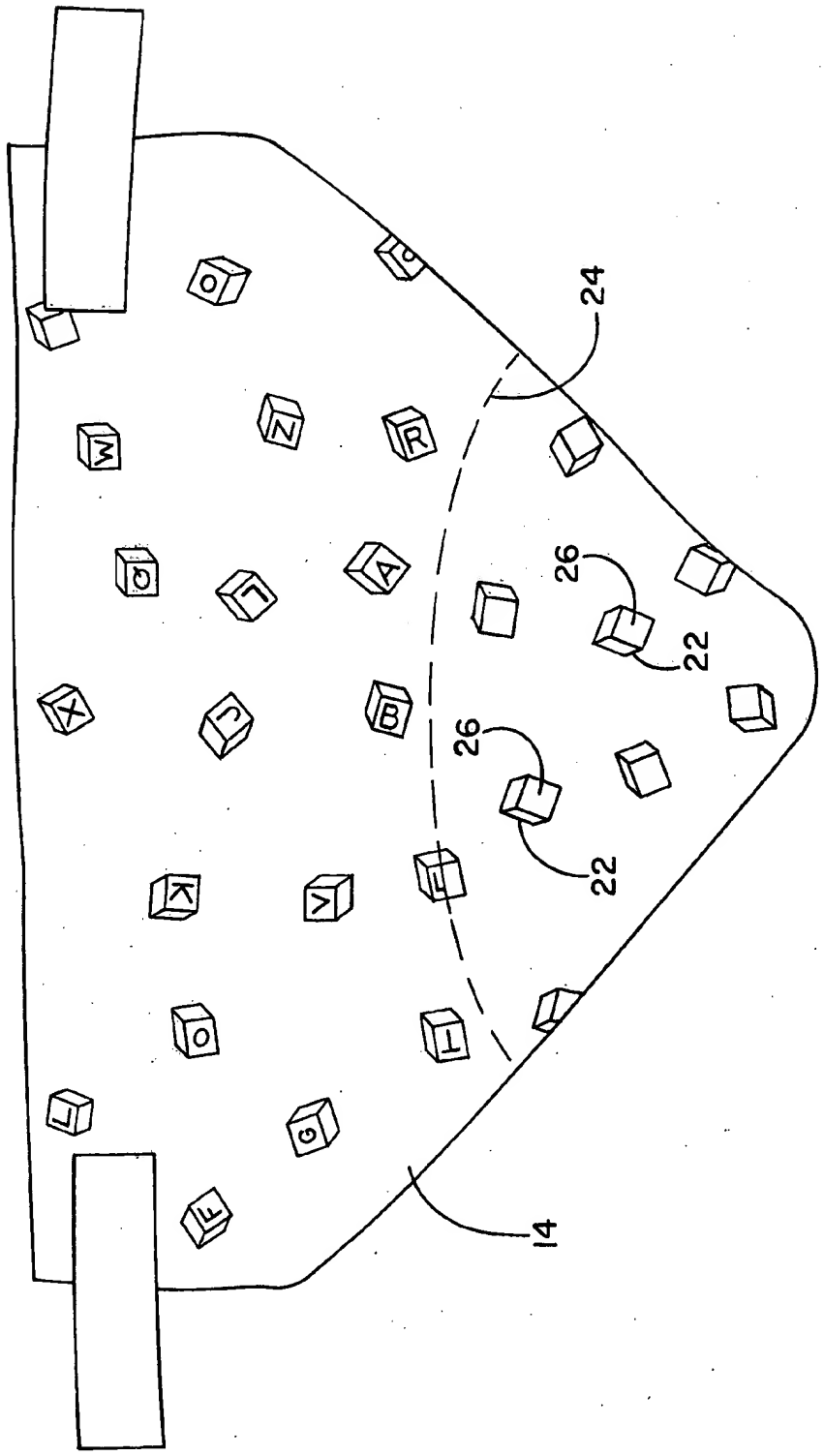


FIG. 6

WETNESS INDICATOR FOR ABSORBENT PADS

This is a continuation, of application Ser. No. 497,475 filed Aug. 14, 1974. now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to indicator means for an absorbent pad assembly, and particularly disposable diapers, which visually signals the user when the pad is wetted by aqueous fluids to assist the user in determining whether or not a fresh pad is needed.

In the prior art a number of such indicators are disclosed for that purpose. However all of these rely on systems wherein the indicator is initially not visible or is temporarily masked. These prior art indicators become visible only after the pad is wetted.

For example, Baker et al U.S. Pat. No. 3,675,654 of July 11, 1972 utilizes an indicator agent which is disposed between a translucent backing sheet and an absorbent pad and comprises either a small amount of finely divided water-soluble dye having a high dye strength of such a dye admixed with a finely divided diluent masking agent such as talcum powder. The indicating agent is applied in dry form and adheres to the pad surface facing the backing sheet where it is substantially invisible through the backing sheet. When the pad and the agent becomes wet from an aqueous body fluid the dye becomes visible through the backing sheet.

Wang U.S. Pat. No. 3,759,261 of Sept. 18, 1973 utilizes an internal layer carrying a printed pattern which is covered by another layer of sufficient density to conceal the printed pattern when the diaper is dry but which when wetted permits the printed pattern to become readily visible.

While each of these perform the desired function of indicating diaper wetness, it was found that some mothers were not in favor of using a system because is also signalled to everyone else that their child was wet and needed changing. A more discreet, less conspicuous means for indicating wetness appeared desirable.

The present invention utilizes such an approach. It provides a wetness indicator while the diaper is dry shows a decorative color or printed pattern through the backing sheet. When a diaper is wetted this color or pattern quickly fades and then substantially disappears from view.

The principle employed in the invention is similar to one found in Sheppard et al U.S. Pat. No. 3,702,610 of Nov. 14, 1972 which teaches the use of a colored water-dispersible adhesive binder for non-woven wrappers which when dropped in the excess water of a toilet is gradually dissolved and dispersed by the water whereby the color migrates away from the bonded areas into adjacent unbonded areas to indicate that the bonded areas are dissolved and that the wrapper is ready for flushing. However, the Sheppard et al indicator system is used for an entirely different function and purpose than that which will be defined herein.

SUMMARY OF THE INVENTION

In the present invention, an absorbent assembly comprising an absorbent pad and a fluid-impervious light-transmitting backing sheet in association therewith has disposed between the pad and backing sheet a wetness indicator in the form of a coloring agent of sufficient color-intensity to be visible through the backing sheet when the pad is dry. The wetness indicator is a water-dispersible coloring agent temporarily affixed to a carrier means disposed at the interface of the pad and backing sheet. A preferred coloring agent is a water-soluble non-toxic dye in a water-dispersible binder.

The carrier means is preferably the backing sheet and a solid or intermittent pattern of the coloring agent is affixed to that side of the backing sheet which faces the pad. A separate absorbent fiber sheet may also be used as the carrier means. When the pad is wetted by body fluids, the coloring agent is dispersed or dissolved, and transported by the fluid from the carrier means into the pad so that it is no longer visible through the backing sheet. The degree and area of color disappearance indicates the degree and area of wetness in the pad. An additional embodiment is the use of a permanent color or pattern in areas adjacent the disappearing color or pattern, the permanent color being unaffected by wetting. This latter modification serves to make the color change less obtrusive or discernible to other persons while still signalling the user that a change is desirable.

The invention is primarily adaptable to disposable diapers but may be used in other absorbent assemblies where wetness indicators are appropriate such as burn dressings, medical bandages, incontinent pads, sanitary napkins and the like.

The above features and advantages of the invention as well as others will become apparent from the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a plan view of an absorbent assembly utilizing the invention in a simplified diaper structure in which the absorbent pad portion is partly turned back.

FIG. 2 is a partial rear view of the diaper structure of FIG. 1 in place on the torso of a child and showing the appearance of the diaper in dry condition.

FIG. 3 is a view similar to FIG. 2 in which the diaper has been wetted.

FIG. 4 is a plan view similar to FIG. 1 but showing another form of the invention.

FIG. 5 illustrates the use of a decorative pattern on a prefolded triangular diaper in another embodiment of the invention.

FIG. 6 illustrates what happens to a pattern similar to that in FIG. 5 after it has become wetted in a particular area.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1 of the drawings, there is illustrated a simplified version of a disposable diaper showing a preferred embodiment of the invention. As shown therein, the diaper comprises an absorbent pad 12 which consists of suitable absorbent materials such as wood pulp fibers, multiple plies of cellulose wadding, absorbent cotton, rayon fibers and the like. This pad is disposed on a water-impervious light transmitting backing sheet 14 which preferably is of translucent or transparent plastic film such as polyethylene. The pad is usually covered by a moisture-pervious cover sheet such as a non-woven fiber web of carded rayon fibers or the like. However, the use of a cover sheet is not essential to the invention. In the FIG. 1 embodiment, that side of backing sheet 14 which faces absorbent pad 12 has affixed thereto a pattern of a water-soluble coloring agent 16, in this instance shown as a discontinuous herringbone pattern. The interior face of the back-

ing sheet thus serves as the carrier means for the coloring agent **16**. A preferred form of this coloring agent is a water-soluble dye in a water-soluble polyvinyl alcohol binder.

In FIG. **2**, the diaper of FIG. **1** is shown in position on the partially-illustrated torso of a child **18**. As indicated in FIG. **2** the pattern of coloring agent **16** is clearly visible through backing sheet **14** and will remain in this condition as long as the absorbent pad is dry. When the pad becomes wetted with urine, that portion of the patterned coloring agent **16** which is in contact with the wetted area is dissolved by the urine and had disappeared from view as shown at area **20** in FIG. **3** where the pattern is no longer visible. The pattern has disappeared only in that area where the pad is wetted.

FIG. **4** illustrates another embodiment of the invention in which a separate carrier means for coloring agent is employed. In this embodiment, in addition to the absorbent pad **12** and light transmitting back sheet **14** of FIG. **1**, a thin absorbent sheet **15** is disposed between pad **12** and back sheet **14**. That side of absorbent sheet **15** which faces back sheet **14** is imprinted with a water-soluble coloring agent **16***a* in a wavy line pattern. This coloring agent is of sufficient intensity in its dry condition to clearly show through back sheet **14** as in FIG. **2**. When this coloring agent is wetted, it also disappears only in the wetted area as illustrated in FIG. **4**. When a supplementary absorbent sheet **15** such as a cellulose tissue, a non-woven web, a thin foam sheet, or the like is employed, the coloring agent **16***a* may be affixed thereon by applying the agent in the form of an aqueous solution which is subsequently dried, or in the form of an aqueous dispersion in association with a water-soluble binder. When a cellulose base sheet is used as the carrier means, the coloring agent or dye employed should be one which preferably is not specific to cellulose in order that the agent will migrate easily with the body fluid when wetted. Many acid dyes are suitable for the latter purpose while some basic and direct dyes are not.

In FIGS. **5** and **6** there is shown an additional embodiment of the invention in which a more decorative pattern is used and in which only a part of the original pattern disappears when wetted. In that embodiment a set of alphabet blocks is depicted as being printed on the inside of backing sheet **14** in scattered array. The outline **22** of each of the blocks is printed in a permanent ink or dye which will not dissolve when wetted by body fluids. The alphabet letters on the blocks are printed with the water-dispersible or water-soluble coloring agent **16***b*. The design is illustrated as it would appear on a prefolded triangular diaper. When the diaper pad is interiorly wetted in the area enclosed below dotted line **24**, as shown in FIG. **6**, the water-soluble letters will disappear as at **26** while the outline of the blocks **22** will remain visible.

It will readily be seen that the coloring agent may be applied in an unlimited variety of decorative patterns in this embodiment, with a portion of the pattern consisting of a permanent coloring agent while the other portion comprises the water-dispersible coloring agent. Contrasting colors are preferred, but monochrome may also be used.

The following specific examples of the invention which were tested in both actual use tests and bench tests will more clearly illustrate its utility.

In one example, large daytime size commercial diapers having a translucent backing sheet of 1 mil thick, white-pigmented taffeta-embossed polyethylene were used for the tests. The diapers were prepared by preprinting the interior side of the polyethylene back sheet with a water-soluble ink in the discontinuous diamond pattern somewhat like the herringbone pattern shown in FIG. **1** of the drawings. The ink was formulated from a 50% solution of Cascorex EA 9065, a polyvinyl alcohol from Borden Adhesives diluted with distilled water. To this was added 0.1% by weight of GAF Neptune Blue BRA dye. The solution was applied to the interior face of the polyethylene by flexographic printing in the selected pattern. The test diapers were otherwise not modified in any other way from their usual commerical form. A number of these test diapers were applied to a group of children of varying age and size. The diapers were checked periodically to determine if they were wet or dry. When there was no visible change in the pattern the diapers were always found to be dry. It was also found flexing of the backing sheet in normal use did not disrupt the pattern and body perspiration had no effect on it. When visual observation of the test subjects showed that a portion of the pattern disappeared, a check of the diaper indicated that the wetted out area substantially coincided with the area in which the pattern had disappeared. Similarly, the area where the pattern did disappear always coincided with the wetted area. Thus wetness indicator as described herein not only signalled wetness but also indicated to some extent the degree and the area of wetting.

In another example, a set of diapers were prepared with a two coloring pattern similar to the style shown in FIGS. **5** and **6** printed on the interior face of the polyethylene backing sheet. The outlines of the alphabet blocks shown therein were printed on the polyethylene film with a flexographic press using a standard permanent polyethylene ink in a pink color (PMS 150 from Inmont Corporation). The film had previously been given a corona discharge treatment leaving a surface energy of about 35 dynes. The letters on the blocks were printed with a solution comprised of 50% water, 50% of water-soluble polyvinyl alcohol (Cascorex EA 9065, about 8% solids from Borden Chemical Company) colored with a tissue dye (Sky Blue 6BX a direct dye from E. I. DuPont Company) in the amount of 0.5% by weight. Each color covered about 3% of the total sheet area.

Diapers constructed with this printed polyethylene employed as the backing sheet were tested in a fashion similar to that described in the previous example. In each instance when a diaper was wetted, the letters printed on the blocks in the form of the water-dispersible Sky Blue 6BX dye disappeared in the wet-out areas while the outline of the alphabet blocks printed in the form of the permanent PMS 150 pink were unaffected and remainded clearly visible. The wetness indicator was effective for a wide range of fluid additions, and in the tests signalled wettings of less than 15 grams of urine to as much as 150 grams or more. This variation of the invention was found to be a more subtle and less conspicuous wetness indicator means than the single pattern earlier described in which only a water-soluble color was used and where the complete pattern disappeared in the wetted area. It is noted that in this embodiment the permanent color pattern may be applied to either side of the backing sheet while the transient color pattern is applied to a carrier means on the interior of the diaper.

Both styles of wetness indicators were reported by the users as being much more desirable in their estimation than the prior art forms in which a color is made to appear rather than disappear to signal wetness.

In still another example, a tissue sheet of wet strength creped cellulose wadding was printed with a plain aqueous solution of an acid dye Dupont Orange 2 and inserted between the absorbent pad and back sheet as shown in FIG. 4. The color was applied in sufficient intensity to show through the light-transmitting backing when dry. When this diaper was tested by wetting areas of the pad, it was found that the color which originally showed through the backing sheet **14** when dry also disappeared when wetted as in the other examples. In this embodiment, the contrast between wet and dry areas, while readily discernible through the backing sheet and serving satisfactorily as a wetness indicator, was not as sharp as when the coloring agent was applied directly to the film backing. Accordingly, the latter embodiment is preferred.

It should also be noted that a permanent color pattern may also be applied to the supplementary absorbent sheet if desired to provide a more decorative effect. The permanent color pattern may also be applied to the backing sheet while the transient coloring agent is applied to the supplemental absorbent sheet.

In addition to the dyes named as coloring agents in the specific examples, a large variety of other water-dispersible or water-soluble coloring agents may be used. The criteria are that these coloring agents are capable or ready dissolution or dispersion in aqueous fluids; that the agents have enough color intensity to be readily visible through a light-transmitting transparent or translucent backing; and, of course, that the agent be nontoxic and non-irritating should it inadvertently contact the skin. Various coloring agents which meet these criteria include acid, basic, and direct dyes; soluble inorganic pigments; food and vegetable colors; and the like.

Some specific coloring agents in addition to those named in the specific examples include Pontamine Turquoise 8 GLP a direct blue dye, Bond yellow CS a direct yellow dye, Dupont Red 8 BLX a direct red dye, Rhodamine B Extra a basic red dye, and Paper Blue R a direct dye all from E. I. DuPont Company; and EASTACRYL dark red LA by Eastman Kodak Company. Brom Thymol Blue, Brom Phenol Blue and Methyl Orange, all acid base dyes have also been successfully tried. Many other dyes and colors are available, and the selection of one with suitable dispersibility or solubility and aesthetic values is no problem.

The coloring agent may be affixed to the carrier means either from a thick aqueous solution or from an aqueous solution containing a water-dispersible binder. The use of a binder is preferred when the coloring agent is affixed to a plastic film backing sheet.

When a binder is used to apply and affix the coloring agent to the substrate, a water-soluble polyvinyl alcohol as set forth in the examples is presently preferred because of its availability, non-toxic characteristics and ease of use. However, other water-dispersible or water-soluble binders may be used including modified cellulosics such as carboxymethyl cellulose or cellulose glycolate and other forms of methyl cellulose and glycol cellulose. Gelatins, gums, starches, dextrins and various sugars are also suitable.

The invention is applicable to disposable pads in all their various forms as long as such pads have a construction which includes a light-transmitting back sheet through which the coloring agent is visible when dry. Transparent or translucent plastic film such as pigmented or non-pigmented polyethylene, polypropylene or vinyl is the preferred form of backing sheet, but water-resistant sheet materials such as non-wovens and the like treated for water-repellancy may also be used as long as they are sufficiently light transmitting to clearly show the coloring agent therethrough. While disposable diapers are the only form of pad described in the specific examples given above, other adsorbent pad uses are contemplated, such as burn dressings, incontinent pads, sanitary napkins and medical and surgical bandages. In other words the invention is applicable to all types of absorbent pads or assemblies which are used to absorb body fluids and the like and where it is desirable to change pads after they have become wetted.

The wetness indicating means may be applied as a solid color pattern, as a connected or disconnected pattern, in a multicolor or monochromatic arrangement and over the entire planar area of the pad assembly or only in selected areas. As indicated earlier, the transient coloring agent may be used alone or in combination with, and in cooperation with, a permanent color pattern.

The coloring agent may be conveniently applied to the carrier means by printing, but other application means such as spraying, dipping, extrusion, wiping or the like may be employed.

The term water-dispersible as used herein and in the claims is meant to include coloring agents and binders which when subjected to aqueous fluids become dispersed therein and transportable therein either as a true molecular solution or as a mobile suspension which can include dispersed particles of colloidal size and larger.

What is claimed is:

1. An improved wetness indicating means in combination with an absorbent assembly in which said assembly is comprised of an absorbent pad and a light-transmitting fluid-impervious backing sheet in association with said pad, said indicating means comprising a water-dispersible coloring agent temporarily affixed to one surface of a carrier means disposed in association with, but separate from, said pad at the interface of said pad and said backing sheet, said pad being free of said coloring agent and said coloring agent being of sufficient intensity to be visible through said backing sheet when said agent is in dry condition, said coloring agent being present in an amount such that when said agent is contacted with aqueous fluid in areas where said pad becomes wetted out due to absorption of said fluid in said pad areas during use, that portion of said agent which is contacted by said fluid in said wetted out pad areas disperses in said fluid and is transported by said fluid away from said carrier means into said wetted out pad areas whereby the dispersed portion of said coloring agent is no longer visible through said backing sheet, the degree and area of the visual disappearance of said agent indicating the degree and area of wetness in said pad.

2. The wetness indicating means of claim **1** wherein said coloring agent is temporarily affixed to said carrier means by a water-dispersible binder.

3. The wetness indicating means of claim **2** wherein said water-dispersible binder is polyvinyl alcohol.

4. The wetness indicating means of claim 3 wherein said carrier means also has affixed thereon a permanent color pattern.

5. The wetness indicating means of claim 2 wherein said carrier means also has affixed thereon a permanent color pattern.

6. The wetness indicating means of claim 1 wherein said carrier means is said backing sheet and said coloring agent is applied to the side of said backing sheet facing said pad.

7. The wetness indicating means of claim 6 wherein said coloring agent is temporarily affixed to said backing sheet by a water-dispersible binder.

8. The wetness indicating means of claim 7 wherein said water-dispersible binder is polyvinyl alcohol.

9. The wetness indicating means of claim 8 wherein said backing sheet also has affixed thereon a permanent color pattern.

10. The wetness indicating means of claim 7 wherein said backing sheet also has affixed thereon a permanent color pattern.

11. The wetness indicating means of claim 6 wherein the side of said backing sheet has affixed thereon a permanent color pattern.

12. The wetness indicating means of claim 1 wherein said carrier means is a thin absorbent sheet, and said coloring agent is applied to the side of said thin absorbent sheet facing said backing sheet.

13. The wetness indicating means of claim 12 wherein said coloring agent is temporarily affixed to said thin absorbent sheet by a water-dispersible binder.

14. The wetness indicating means of claim 13 wherein said water-dispersible binder is polyvinyl alcohol.

15. The wetness indicating means of claim 14 wherein said thin absorbent sheet also has a permanent color pattern affixed thereon.

16. The wetness indicating means of claim 6 wherein said thin absorbent sheet has also affixed thereon a permanent color pattern.

17. The wetness indicating means of claim 12 wherein a permanent color pattern is also applied to the side of said thin absorbent sheet facing said backing sheet.

18. The wetness indicating means of claim 1 wherein said carrier means also has affixed thereon a permanent color pattern.

19. The wetness indicating means of claim 18 wherein said permanent color pattern is of a different color than said coloring agent.

* * * * *

US005232894A

United States Patent [19]

Chosa

[11] Patent Number: 5,232,894

[45] Date of Patent: Aug. 3, 1993

[54] THERMAL TRANSFER RECORDING MEDIUM

[75] Inventor: Yosei Chosa, Saitama, Japan

[73] Assignee: Toppan Printing Company, Ltd., Tokyo, Japan

[21] Appl. No.: 820,974

[22] Filed: Jan. 15, 1992

[30] Foreign Application Priority Data

Jan. 16, 1991 [JP] Japan 3-015769

[51] Int. Cl.[5] B41M 5/035; B41M 5/38

[52] U.S. Cl. 503/227; 428/195; 428/913; 428/914

[58] Field of Search 8/471; 428/195, 913, 428/914, 507; 503/227

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Primary Examiner—B. Hamilton Hess
Attorney, Agent, or Firm—Staas & Halsey

[57] ABSTRACT

A thermal transfer recording medium comprises a substrate and, laminated thereto, an ink layer containing a sublimation dye and a binder resin. The binder resin comprises (a) from 60 to 90% by weight of polyvinyl butyral with a degree of polymerization of from 1,500 to 2,500 and a glass transition point of not lower than 70° C., and (b) from 10 to 40% by weight of ethyl cellulose with a glass transition point of not lower than 130° C.

3 Claims, 1 Drawing Sheet

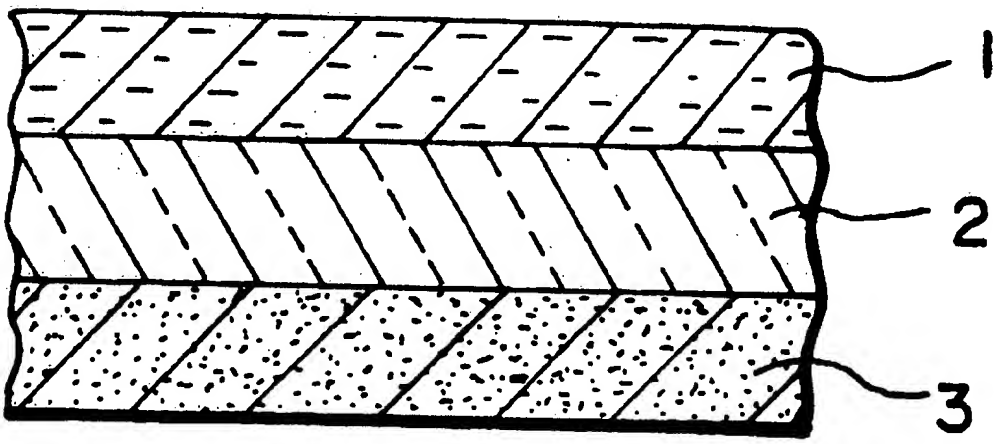
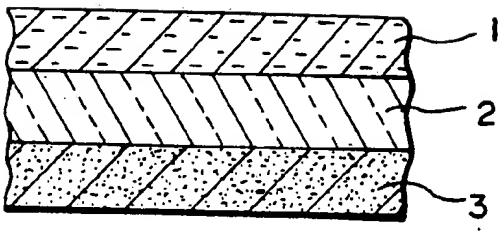


FIG. 1



THERMAL TRANSFER RECORDING MEDIUM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a thermal transfer recording medium. More particularly, the present invention relates to a thermal transfer recording medium for recording an image on a transfer medium (or image-receiving medium) such as paper, using a thermal head.

2. Description of the Related Art

Conventional methods of recording color images make use of a printing system such as offset printing and, in addition thereto, an ink-jet recording system, an electrostatic toner recording system or a thermal transfer recording system. In particular, the thermal transfer recording system can make compact an apparatus in which it is to be used and requires only simple maintenance. Hence, this system is widely used. In particular, a system making use of a sublimation dye (hereinafter "sublimation transfer system") can provide an image with an excellent gradation and is suitable for instances in which images are recorded in full colors.

In such a sublimation transfer system, recording mediums used are exemplified by those comprised of a lamination of a heat-resistant sliding layer, a substrate film and an ink layer comprising a sublimation dye and a binder resin, and transfer mediums used are those comprised of a substrate such as paper or plastic film and laminated thereto with a dyeable resin layer. Such transfer medium and thermal transfer recording medium are brought into pressure contact at the interface between a thermal head and a platen roll, and heat corresponding with image signals is applied to that interface from the thermal head, so that a transferred image is formed.

In conventional thermal transfer recording mediums, however, the sublimation dye contained in the ink layer causes a phenomenon of agglomeration and with time, gives a phenomenon of bleeding to the surface of the ink layer. This has tended to cause adhesion of the sublimation dye also to non-image areas of the transfer medium when transfer images are formed, and what is called background staining occurs, resulting in a serious lowering of image quality.

In order to prevent such phenomenons, it has been hitherto proposed to use as a binder in the ink layer a binder composition containing 90% by weight or more of polyvinyl butylal having a molecular weight of from 60,000 to 200,000 (Japanese Patent Application Laid-open No. 60-101087).

Such polyvinyl butyral, however, has so poor a fluidity that an ink making use of a binder resin containing it in an amount of 90% by weight or more lacks desired coating properties. In instances in which such an ink is applied to a substrate sheet to prepare a thermal transfer recording medium, coating uneveness may occur to cause what is called pinholes in the ink layer of the thermal transfer recording medium. Thus, there has been the problem that image qualities such as resolution are lowered when images are formed using a thermal transfer recording medium in which such pinholes are present.

SUMMARY OF THE INVENTION

The present invention was made in order to solve the above problems in the prior art. An object of the present invention is to provide, in the sublimation transfer system, a thermal transfer recording medium that can be free of the dye agglomeration or bleeding and also does not cause any faulty transfer such as background staining even after storage for a long period time.

The present inventor has discovered that the above object of the present invention can be achieved when a composition containing polyvinyl butyral and ethyl cellulose, which have specific properties and are used in a specific proportion, is employed as a binder resin used in an ink layer, and thus has accomplished the present invention.

The present invention provides a thermal transfer recording medium comprising a substrate and, laminated thereto, an ink layer containing a sublimation dye and a binder resin, wherein said binder resin comprises (a) from 60% by weight to less than 90% by weight of polyvinyl butyral with a degree of polymerization of from 1,500 to 2,500 and a glass transition point of not lower than 70° C., and (b) from 10% by weight to 40% by weight of ethyl cellulose with a glass transition point of not lower than 130° C.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a cross-sectional illustration of an embodiment of the thermal transfer recording medium of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The thermal transfer recording medium of the present invention will be described below in detail with reference to the accompanying drawing.

FIG. 1 cross-sectionally illustrates a thermal transfer recording medium according to a preferred embodiment of the present invention. In the embodiment shown in the drawing, an ink layer 1 is provided on a substrate 2, and a heat-resistant sliding layer 3 is provided on the surface of the substrate 2 on its side opposite to the side on which the ink layer 1 is provided.

The ink layer 1 contains a binder resin and a sublimation dye. The binder resin used in the present invention contains polyvinyl butyral and ethyl cellulose of specific types.

More specifically, the polyvinyl butyral used in the present invention has a degree of polymerization of from 1,500 to 2,500, preferably from 1,600 to 2,400, and more preferably from 1,700 to 2,400, and a glass transition point of not lower than 70° C., and preferably not lower than 80° C.

A polyvinyl butyral with a degree of polymerization less than 1,500 may give an excessively low transfer density and one with a degree of polymerization more than 2,500 may result in excessively low coating properties.

An increase in the degree of polymerization of polyvinyl butyral makes molecules of polyvinyl butyral so large that their entanglement becomes coarse. This may bring about a weak retention of sublimation properties and tend to cause ready sublimation of the sublimation dye. As a result, a higher degree of polymerization tends to bring about a higher transfer density. An excessively high degree of polymerization, however, makes the resin itself hard, resulting in a lowering of coating properties. On the other hand, a polyvinyl butyral with a low degree of polymerization can bring about an improvement in the coating properties, but may increase the power to retain the dye, tending to result in

a decrease in the transfer density. That is, the degree of polymerization of polyvinyl butyral and the transfer density positively correlate with each other and, on the other hand, the degree of polymerization and the coating properties negatively correlate with each other. Thus, taking account of the conflicting tendency the degree of polymerization of polyvinyl butyral gives to the transfer density and coating properties, it is necessary to select the polyvinyl butyral used from those having properties within the above ranges.

When transfer recording is carried out, the thermal transfer recording medium is heated to 200° C. or above in a short time, and hence there is a possibility that the ink layer 1 melt-adheres to the transfer medium if the binder resin of the ink layer 1 has a low glass transition point. Accordingly, it is necessary to use polyvinyl butyral having a glass transition point of not lower than 70° C.

In the present invention, the binder resin comprises the polyvinyl butyral as described above, in addition to which an ethyl cellulose with a glass transition point of not lower than 130° C., and preferably not lower than 145° C., is used in combination. Use of only the above polyvinyl butyral without use of such an ethyl cellulose may make low the fluidity of the binder resin and bring about poor coating properties, which makes it impossible to obtain a uniform coating surface. Use of the ethyl cellulose having a compatibility with the polyvinyl butyral and a glass transition point of not lower than 130° C. makes it possible to improve the coating properties of the binder resin to give a uniform coating surface, and also makes it possible to improve the thermal resistance of the thermal transfer recording medium. However, incorporation of the ethyl cellulose in excess may cause faulty transfer such as background staining because of a poor dye retention inherent in the ethyl cellulose. Accordingly, the binder resin used in the present invention is composed in such a proportion that the polyvinyl butyral is in an amount of from 60% by weight to less than 90% by weight, preferably from 70% by weight to 85% by weight, and more preferably 80% by weight, and the ethyl cellulose is in an amount of from 10% by weight to 40% by weight, preferably from 15% by weight to 30% by weight, and more preferably 20% by weight.

As the sublimation dye used in the ink layer 1, commonly used sublimation dyes can be widely used, as exemplified by those of a diarylmethane type, a triarylmethane type, a thiazole type, a methine type, an azomethane type, a xanthene type, an oxazine type, a thiazine type, an azine type, an acridine type, an azo type, a spirodipyran type, an indolynospirodipyran type, a fluorane type, a Rhodamine type or an anthraquinone type.

The ink layer 1 may also be appropriately incorporated with various additives such as pigments, surface active agents, softening agents, and substances capable of absorbing electromagnetic waves to liberate heat.

The mixing proportion of the sublimation dye and binder resin that constitute the ink layer 1 may vary depending on the type of dyes, composition of binder resin, heating temperature during thermal transfer, heating time therefor, etc. In usual instances, they may be mixed in such a proportion that the sublimation dye is in an amount of from 1 to 15% by weight, and preferably from 3 to 10% by weight, and the binder resin is in an amount of from 2 to 20% by weight, and preferably from 5 to 15% by weight.

The ink layer 1 may preferably have a layer thickness of from 0.1 to 3.0 μm, and more preferably from 0.3 to 1.5 μm.

The substrate 2 used in the present invention may include substrates commonly used in thermal transfer recording mediums, as exemplified by plastic films such as polyester films, polystyrene films, polysulfone films, polyimide films, polyvinyl alcohol films, aromatic polyamide films and aramid films, or thin paper sheets such as cellophane and condensor paper, which can be appropriately used according to the purpose.

The substrate 2 may preferably have a thickness of from 3.5 to 12.0 μm, and more preferably from 4.5 to 9.0 μm.

The substrate 2 may also be appropriately provided, on its side on which the ink layer 1 is not formed, with a heat-resistant sliding layer 3 as shown in FIG. 1, if necessary for the purpose of preventing the substrate 2 from melt-adhering to a thermal head. Such a heat-resistant sliding layer 3 can be formed utilizing silicone mixtures or silicone-modified products of resins such as acrylic resins, urethane resins, cellulose resins, epoxy resins, and silicone resins. The heat-resistant sliding layer 3 may preferably have a thickness of from 0.1 to 1.5 μm, and more preferably from 0.1 to 0.8 μm.

The thermal transfer recording medium of the present invention can be produced by conventional methods. For example, an ink comprising the sublimation dye, the binder resin and a solvent is coated on the surface of the substrate 2 by means of a gravure coater or the like, followed by drying to form the ink layer 1, and a composition for the heat-resistant sliding layer is coated on the surface of the substrate 2 opposite the surface on which the ink layer 1 has not been formed, followed by drying to form the heat-resistant sliding layer 3. Thus, the thermal transfer recording medium of the present invention can be produced.

The thermal transfer recording medium of the present invention can be applied not only in recording apparatus in which a thermal head is used as a heating means for transfer, but also in recording apparatus in which infrared rays or laser beams are used as the heating means.

The binder resin that contitutes the ink layer of the thermal transfer recording medium according to the present invention is comprised of the polyvinyl butyral and ethyl cellulose having the specific properties and used in the specific proportion, and hence has superior coating properties, so that the ink layer of the thermal transfer recording medium according to the present inventin can have an even, uniform coating surface. Moreover, the thermal transfer recording medium of the present invention can be free from the phenomenon of agglomeration or bleeding of the sublimation dye even after storage for a long period of time, and also enables image recording free from faulty transfer such as background staining.

EXAMPLES

The present invention will be more specifically described below. In the following Examples "part(s)" refers to "part(s) by weight".

Examples 1 to 3, Comparative Examples 1 to 5

On a polyester film with a thickness of 5.7 μm (LUMIRROR 6CF53; trade name; available from Toray Industries, Inc.), the compositions formulated as shown in Table 1 were each coated in a dried coating

weight of 1.0 g/m² using a gravure coater. On the back surface thereof, a composition comprised of 5 parts of acrylic resin (BR85; available from Mitsubishi Rayon Co., Ltd.), 1 part of silicone oil (KP360; available from Shin-Etsu Chemical Co., Ltd.) and 94 parts of toluene was further coated in a dried coating weight of 1.0 g/m² using a bar coater, followed by drying to provide a heat-resistant sliding layer. Thermal transfer recording mediums were thus obtained.

The resulting thermal transfer recording mediums were each set on a video printer GZ-21, manufactured by Sharp Corp., and a video image was transferred to a commonly available transfer medium having a dyeable layer comprising an ester resin, at an energy of 1.0 mJ/dot. Examinations were made on the following items.

Transfer Density

Using Macbeth RD918, the transfer density of each transferred image was measured. Results obtained are shown in Table 2.

Coating Surface

The state of the coating surface of each ink layer was visually examined. Results obtained are shown in Table 2. In the table, "A" indicates an instance where no uneveness occurs in the transferred image; "B", an instance where uneveness slightly occurs in the transferred image; and "C", an instance where uneveness occurs in the transferred image and the medium is untolerable for practical use.

Background Staining

Visual observation was made on how the dye has adhered to the marginal white frame, what is called the white background, of each transfer medium to which the video image has been transferred. Results obtained are shown in Table 2. In the table, "A" indicates an instance where no background staining occurs; "B", an instance where no background staining slightly occurs; and "C", an instance where background staining occurs and the medium is untolerable for practical use.

Melt-adhesion of Ink Layer

During the operation of thermal transfer, visual observation was made on whether or not the ink layer has melt-adhered to the transfer medium. Results obtained are shown in Table 2. In the table, "A" indicates an instance where no melt-adhesion occurs during transfer; and "C", an instance where melt-adhesion occurs.

TABLE 1

	Polyvinyl butyral	Ethyl cellulose	Dye	Solvent
Example:				
1	8 parts	2 parts	10 parts	80 parts
2	6 parts	4 parts	10 parts	80 parts
3	8 parts	2 parts	10 parts	80 parts
Comparative Example:				
1	9.5 parts	0.5 part	10 parts	80 parts
2	9 parts	1 part	10 parts	80 parts
3	5 parts	5 part	10 parts	80 parts
4	8 parts	2 part	10 parts	80 parts
5	8 parts	2 part	10 parts	80 parts

As the polyvinyl butyral, in Examples 1 and 2 and Comparative Examples 1 to 3, S-LEC BZ-1 (trade name; degree of polymerization: 1,700; glass transition point: 85.5° C.), available from Sekisui Chemical Co., Ltd., was used. In Example 3, 6000EP (degree of polymerization: 2,400; glass transition point: 89° C.), available from Denki Kagaku Kogyo Kabushiki Kaisha, was used. In Comparative Example 4, S-LEC BH-3 (trade name; degree of polymerization: 1,700; glass transition point: 63.3° C.), available from Sekisui Chemical Co., Ltd., was used. In Comparative Example 5, S-LEC BH-S (trade name; degree of polymerization: 1,000; glass transition point: 58° C.), available from Sekisui Chemical Co., Ltd., was used.

As for the ethyl cellulose, in Examples 1 to 3 and Comparative Examples 1 to 5, N-7 (glass transition point: 156), available from Hercules Inc., was used. As for the dye, in Examples 1 and 2 and Comparative Examples 1 to 3, MS-Magenta-VP, available from Mitsui Toatsu Chemicals, Inc., and in Example 3 and Comparative Examples 4 and 5, Ceresblue-GN, available from Bayer AG, was used. In all of these Examples and Comparative Examples, a 1/1 mixture of toluene/methyl ethyl ketone was used as the solvent.

TABLE 2

	Transfer density	Coating surface	Background staining	Melt-adhesion
Example:				
1	1.8	A	A	A
2	1.9	A	B	A
3	1.8	A	A	A
Comparative Example:				
1	1.8	C	A	A
2	1.8	B	A	A
3	1.9	A	C	A
4	1.6	A	A	C
5	1.4	A	A	C

As described above, the recording medium of the present invention can be free from the phenomenon of bleeding of the sublimation dye even after storage for a long period of time, can also be free from background staining, melt-adhesion of the ink layer 1 to the transfer medium and faulty transfer caused by coating uneveness of the ink layer, and can obtain superior transferred images with a high transfer density.

What is claimed is:

1. A thermal transfer recording medium comprising a substrate and, laminated thereto, an ink layer containing a sublimation dye and a binder resin, wherein said binder resin comprises (a) from 60% by weight to less than 90% by weight of polyvinyl butyral with a degree of polymerization of from 1,500 to 2,500 and a glass transition point of not lower than 70° C., and (b) from greater than 10% by weight to 40% by weight of ethyl cellulose with a glass transition point of not lower than 130° C.

2. A thermal transfer recording medium comprising a substrate and, laminated thereto, an ink layer containing a sublimation dye and a binder resin, wherein said binder resin comprises (a) from 70% by weight to less 85% by weight of polyvinyl butyral with a degree of polymerization of from 1,500 to 2,500 and a glass transition point of not lower than 70° C., and (b) from 15% by weight to 30% by weight of ethyl cellulose with a glass transition point of not lower than 130° C.

3. The thermal transfer recording medium according to claim 2, wherein said binder resin comprises (a) 80% by weight of polyvinyl butyral with a degree of polymerization of from 1,500 to 2,500 and a glass transition point of not lower than 70° C., and (b) 20% by weight of ethyl cellulose with a glass transition point of not lower than 130° C.

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